STREAM HABITAT RESTORATION GUIDELINES

Chapter 1

INTRODUCTION

Few endeavors in resource and environmental management in the Pacific Northwest are more compelling than rapidly expanding efforts to restore the region's streams and rivers. The region's history, and strongly held modern values are inseperably intertwined with our streams and rivers. Riparian ecosystems compose the sole habitat, or critical habitat elements for a majority of the region's native wildlife. The rich floral and faunal biodiversity is the basis for much of the state's cultural heritage, economy, and famed quality of life.

After more than a century of degrading impacts from a multitude of economic activities following Euroamerican settlement, recognition of the need to restore streams has spread throughout the Puget Trough, watersheds draining directly to the Pacific Ocean, and the entire Columbia Basin. Much of this awareness and activity is driven by the serious decline of the region's once robust runs of wild salmon, but also stems from a desire to restore wild populations of resident anadromous fish, including redband, cutthroat, and bull trout. Over the past decade and more, many aquatic and riparian species have been listed as threatened or endangered under the federal Endangered Species Act and the Washington Wildlife Code.

Availability of clean cool water for a host of human needs also depends on healthy stream systems in functionally intact watersheds. A long list comprising a large majority of the state's major rivers and hundreds of tributary streams fail to attain federal and state water quality standards for a host of heavy metals and toxic comppounds, turbidity, dissolved oxygen and nutrients. Great progress has been achieved in reducing industrial and municipal point sources of water pollution, yet a large challenge remains to achieve and maintain reductions of urban, rural and wildland sources of non-point water pollution.

The purpose of these guidelines is to promote process based natural stream rehabilitation, in which stream restoration is aquatic and riparian ecosystem restoration. Rather than a linear approach to restoring a single species, these guidelines advance a watershed scale assessment of the stream system, establishing goals, objectives and design for rehabilitating optimum sustainable native biodiversity, using principles of landscape ecology and integrated aquatic ecosystem restoration.

This Stream Habitat Restoration Guidelines volume presents users with a comprehensive list of factors in watershed assessment, geomorphic, hydrologic and ecological characterization, land use and financial contstraints, and technical approaches to consider in designing effective stream habitat rhabilitation. While a number of specific watershed assessment, characterization, project design and construction approaches are presented, these Guidelines are not a "cookbook" approach from which single elements can be

extracted and used effectively in the field. Stream habitat restoration should always be evaluated and designed as restoring fluvial and ecological processes, at the watershed scale. This approach is often called Integrated Resource Management, in which stream restoration can be conceived as Integrated Aquatic Ecosystem Restoration, and Watershed Restoration.

Stream Habitat Restoration Guidelines within the Aquatic Habitat Program.

This Stream Habibat Restoration Guidelines volume is part of a series of guideline products produced through the Aquatic Habitat Guidelines program (AHG), a joint effort among state and federal resource management agencies in Washington, which include the Washington Departments of Ecology, Fish and Wildlife, Transportation, the United States Fish and Wildlife Service, and the United States Army Corps of Engineers. The Aquatic Habitat Guidelines are designed to address the urgent need for increased and broadly accepted technical guidance, to ensure that stream restoration efforts for salmon and trout recovery and watershed restoration are strategic, ecologically appropriate, and optimize the effective investment of public and private resources. Aquatic Habitat Guidelines do not replace existing regulatory requirements, though they are designed in part as technical guidance supporting regulatory streamling and grant application review. Other AHG products include the Integrated Streambank Protection Guidelines, Fish Passage at Road Culverts, fishway design and evaluation, and fish screen guidelines.

Many of the ecological and resource management issues addressed in these guidance documents have been explored in a series of state-of-the-knowledge white papers produced by regional and national experts as part of the AHG program series. These White Papers may be viewed and downloaded from the internet, and are found on the AHG website maintained by the Washington Department of Fish and Wildlife (http://www.wa.gov/wdfw/hab/ahg/). This website also presents an overview of the Aquatic Habitat Guidelines program, executive summaries of the the White Papers, AHG Guiding Principles, draft guidance documents, and news of upcoming training and other events.

The Process Based Approach

Degraded stream systems reflect degraded conditions in their contributing watersheds. Degraded or altered conditions in all watersheds in the working landscape reflect similar patterns, from forested or shrub-steppe wildlands managed for grazing and timber production, to agricultural lands, to intensively urbanized watersheds. These patterns are watershed “hardening” and associated increases in sediment inputs, streamflows after precipitation events, seasonal and annual snowmelt runoff. The annual hydrograph is also changed, as high flows often increase while seasonal low flows (base flows) decline or cease.

Watershed hardening is obvious and intuitively understood in urbanized watersheds, and erosion associated with agriculture is well recognized by the public. Gains have been realized in broadening public awareness of adverse impacts resulting from draining and filling wetlands . Inappropriate logging, associated roadbuilding, and overgrazing result in soil compaction and erosion. In working wildlands, snowmelt is accelerated when the tree canopy is opened or eliminated (Satterlund, 1991), and runoff increases as soil infiltration declines. Reduced soil infiltration reduces bank storage (groundwater recharge), causing decline or cessation of summer and fall low flows in streams. Thus, increased stream flows after storms and snowmelt, combined with increased sediment inputs from erosion degrade stream channels, which, in aboriginal conditions, evolve in dynamic equilibrium with the geological, biotic and climatic conditions of their drainages. These changes in stream flows and sediment inputs often destabilize stream channels, mobilizing more sediments from their beds and banks. Stream restoration efforts applied solely on the stream and its riparian corridor will not succeed or persist if the degraded condition of the tributary watershed is not addressed beforehand or simultaneously.

Ecological processes create and maintain habitat function for fish and wildlife, and all other ecosystem components. These include the interaction of water, sediment and wood which create channels and shoreline structure, which are geomorphic processes. Geomporphic processes include hydrologic response, sediment transport, woody debris influences, erosion and accretion, fire, and channel evolution and migration. Changes in the behavior and routing of water in the watershed result in changes in geomorphic processes in stream systems. Biological processes which interact in complex pathways with geomorphic processes include nutrient cycling, riparian and upland vegetation dynamics, soilbuilding and species mediated habitat forming processes such as beaver activity.

Anadromous and resident salmonids, and thousands of other organisms have coevolved and adapted to exploit the habitats created by these processes. Sustaining wild, naturally occurring populations of these species depends on sustaining the biotic and geomorphic ecological processes of watersheds and their aquatic ecosystems.

Watershed scale ecological processes have been altered or lost historically in the Pacific Northwest, resulting from a broad array of human activities, including intensive beaver trapping, urban, suburban and industrial development, agriculture, timber harvest, mining, overgrazing, structural flood control and channelization, surface water withdrawal for agricultural irrigation, domestic, commercial and industrial use, construction and operation of roads, railroads, pipelines, electrical distribution lines, and construction and operation of dams and reservoirs for irrigation and power generation. Our society as a whole bears responsibility for these impacts, which has both accompanied development of the region's diverse economy, and diminished our natural heritage, economic and recreational opportunity based on this heritage, and its potential as a source for future economic opportunities.

Diverse land use and economic activities compete among each other for water and floodplain real estate, while these same resources are vital for restoring and sustaining aquatic ecosystems, including wild anadromous salmon and trout. While the guidelines in this volume address instream flows, riparian and floodplain land acquisition as issues and potential tools for stream habitat restoration, in-depth discussion of specific resolution of these issues lies outside the scope of these pages. Specific watershed planning legislation, the Watershed Planning Act, RCW 90.82, addressing water quantity, and potentially water quality and habitat, is being implemented in most of Washington's 62 water resource inventory areas.

Restoration or Rehabilitation

Veterans of resource management and historical efforts at ecological restoration have long been aware that restoring aboriginal ecosystems and habitats is supremely difficult,and rarely if ever achieved. Newcomers to this field of endeavor soon learn the same. Achieving aquatic ecosystem restoration is a worthy goal, yet it implies a clear understanding of what aboriginal conditions were, and current and future circumstances which will allow full restoration, including full control of all human and economic activities in the affected watersheds. These conditions are approximated only in certain park and wilderness areas, not in the region's working landscape.

In most cases, soil profiles, soil microbial and mycorhizzal communities, plant communities, and hydrologic conditions are permanently altered or subject to unpredictable fluctuations driven by urbanization and other watershed hardening, irrigation diversions, wetland reductions, etc. Sediment recruitment and inputs are also frequently increased from elevated erosion, or reduced in tailwater streams below dams. Additional missing or greatly attenuated ecological processes include nutrient cycling from reduced or lost anadromous fish runs. Other altered conditions which won't be immediately improved include water quality parameters. Accelerated action toward water pollution reduction under the federal Clean Water Act is underway in the form of Total Maximum Daily Load (TMDL) plans, emphasizing control of nonpoint sources. However, these plans will be years in implementation. Thus, the watershed based analysis and characterization yields awareness that stream habitat *rehabilitation* is a more accurate, achievable and defensible approach in most cases.

There will be circumstances where restoring a stream's natural channel morphology from a ditched and straightened condition is a highly feasible opportunity, with regard to planform geometry or meander form, and longitudinal profile including pools, riffles, runs and sediment composition. In these cases creation is a legitimate design approach.

Stream restoration may also be best implemented as an exercise in riparian corridor protection through livestock exclusion, acquisition in fee simple, or less than fee alternatives like conservation easements, in circumstances where the degree of degradation is moderate enough to facilitate a healing response without requiring invasive earth moving, structural measures or revegation. Other measures include critical

area designation under the Growth Management Act, or appropriate environment designation under the Shoreline Management Act and local Shoreline Master Programs.

Protective measures voluntarily executed through deed amendments or contracts are often more durable and effective than regulatory measures. Protective measures may also result in rapid stream corridor response, if adequate evaluation of the watershed and treatment reach has been conducted, for example using physical function Proper Functioning Condition assessment, resulting in an assessment of PFC or PFC at-risk.. Additional protective measures include addressing watershed degradation in uplands, including land use, agricultural best management practices, improved grazing and range restoration, and improved timber harvest and roadbuilding practices. The importance of addressing degraded conditions and ecological processes throughout the watershed as critical to any stream habitat restoration designs cannot be overstated.

Restoration Sequencing

Stream Habitat Protection begins, and fits within a continuum ranging through revegetation, to aggressive channel realignment and structural measures, all evaluated and designed in context of an adequate assessment of watershed conditions. The essential first step in stream habitat restoration is an adequate comprehensive watershed analysis and assessment, which characterizes watershed processes outlined in preceeding paragraphs. Many such efforts are completed or underway throughout Washington, supporting or implementing the Salmon Recovery Act (ESB 2496) limiting factors analysis, Washington Department of Natural Resources watershed assessment, watershed planning under RCW 90.82, subbasin assessment conducted as part of the Interior Columbia Basin Ecosystem Management Plan, and many others. Watershed-scale asssessment should include adequate evaluation of hydrology and geomorphology of the subject stream system, to characterize flows and extent of channel degradation or relative integrity.

In all cases, the preferred and first approach should be stream restoration accompanying watershed restoration. Less invasive design approaches including riparian livestock exclusion and ecologically appropriate revegetation are preferred over more invasive and aggressive channel modifications or structures, including log or rootwad placement. Channel modifications require terraforming and expensive machine time, in addition to extensive engineering, hydraulics and hydrologic design, and construction oversight.

SHRG Emphasis

The Stream Habitat Restoration Guidelines emphasizes watershed process analysis and assessment, leading to process-based stream habitat restoration and rehabilitation. Watershed assessment usually involves multiple ownerships, often complex patchworks of private and public land ownership laced with transportation infrastructure and utility easements. Planning stream restoration requires some level of participation by the many

different stakeholders in the watershed, and public concensus and support for the work dramatically increases the likelihood of success and long term outcomes. These guidelines do not address the specifics of public participation in watershed planning and stream habitat restoration design, but focus primarily on the technical aspects of ecological process evaluation and restoration design. The interested reader will do well to consult the excellent multi-agency federal publication, Stream Corridor Restoration: Principles, Processes, and Practices, published in 1998 and available from the US Department of Agriculture as National Engineering Handbook 210-VI.

Additional guidance for local public participation is available through local Conservation Districts and Watershed Planning Units, Resource Conservation and Development entities, and other local resource management units working at the watershed scale.